Space Weather Forecast

Issued on Tuesday, 24 January 2023 at 12:34 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Reducing risk of R1/R2 Radio Blackouts and G1/Minor Geomagnetic Storms after midweek (UTC).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been low over the past 24 hours, with only Common-class X-ray activity observed. These flares peaked with an event from an apparently fading southwestern sunspot at 24/0426UTC, which was becoming increasingly difficult to analyse as it neared the southwestern horizon.

The above sunspot group was one of eight confirmed on the Earth-facing side at present, while a former group became indistinct in the northwest and was consequently dropped from the analysis. This was counteracted in part by the potential development of a new tentative northeastern magnetically bipolar region overnight UTC, while another unipolar region rotated onto the northeast.

In terms of the confirmed sunspot groups, one still dominates in terms of size and nominal complexity, showing as a consolidating and growing bipolar group as it nears the western solar horizon. Changes in other spots on the disc were more subtle, with some movement of their constituent spots in several, although for the most part these groups were well-spread in their composition and magnetically simple.

There are currently numerous 'filaments' (arcs of plasma) on the Sun, with most of these concentrated near the western horizon in both hemispheres, which is of note as they could be triggered by the more active sunspots here should they flare appropriately. This appears to have resulted in activity into the UTC morning of the current day, with a large filament becoming mobile between 24/0800-1000UTC in the northwest. It is not yet clear whether this movement has translated into an Interplanetary Coronal Mass Ejection (ICME), however satellite imagery will be monitored. Imagery otherwise showed one northwest-directed and likely far-sided emission from 24/0600UTC.

Finally a possible CME may have been generated by a minor common class flare at 24/0324UTC near the middle of the Sun, although the nearest ejecta appears to be heading northeast from limited imagery available. No new Earth-directed CMEs were therefore in evidence at the time of writing, however this final event remains to be analysed.

Solar Wind / Geomagnetic Activity: Solar winds were suggestive of the tail end of influence from a CME. The shock from this feature had been diagnosed as having reached Earth around 23/0300UTC, with this subsequently evolving into a more typical CME signature from the very start of the current reporting period, i.e. 23/1200UTC, with the solar wind's magnetic field showing discontinuities at both points. The CME responsible is not certain, but is most likely to be the 19 January faint halo or the southwest filament from 20 January - or perhaps a combination of both given the faster speed of the latter and the potential for a 'cannibalistic'

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united front (where a faster second CME catches an earlier slower one - aided by the fact that the former sweeps interplanetary material clear for the latter to move unimpeded).

The solar wind speed was again erratic (as measured) but perhaps best described as an overall decreasing trend from Elevated to Slightly Elevated levels. The number of particles comprising the wind was slightly above average at first, but again with a slight fall observed with time. The magnetic field associated with these particles was greatest early in the 24 hours and showed a smooth decaying envelope into a normal background range by the period's end. The north-south component of the magnetic field was mainly anti-aligned with Earth's field (usually to greater geomagnetic effect) to end the UTC day of Monday 23 January, but generally followed a smooth sinusoid into co-aligned territory into the current UTC day, eventually becoming more erratic as the CME gave way to a more nominal solar wind regime.

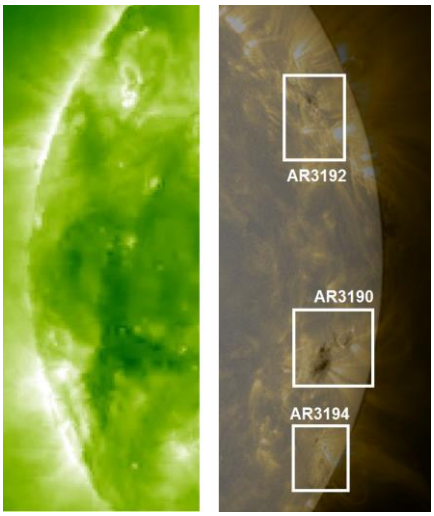
The net effect of the above solar wind measures was mostly quiet, with a provisional peak in the 12-15UTC interval with the incipient CME, although this was well below Minor Storm G1.

Energetic Particles / Solar Radiation: No solar radiation storms were observed.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is carries a daily chance of becoming moderate, with the most potent regions in the southwest. These should rotate off the Sun after midweek UTC to slightly reduce the daily chances of Moderate-class activity.

Figure 1: (Left) 24/1000UTC false-colour extreme UV imagery showing around a day's worth of arriving bright X-ray flux regions containing potential sunspot groups; Right: visible and extreme UV flase-colour composite for 24/1000UTC showing the three main sunspot regions (and their numbers), all soon due to depart the Earth-facing side.



Solar Wind / Geomagnetic Activity: The geomagnetic forecast is of lower than average confidence for the period. The likelihood of any outstanding CMEs now affecting Earth is much-reduced, and any remaining in transit should have passed the radius of Earth's orbit by midweek.

The forecast therefore mainly comprises up to two fast wind streams, the first of which was due today but appears to be slower than anticipated from evidence available from a satellite around a day upwind. There is now considered a slight chance of Minor Geomagnetic Storm G1 on Wednesday 25 January, easing later this week to potentially be succeeded by a similar risk of

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G1 before the UTC weekend in the second fast wind.

Energetic Particles / Solar Radiation: Solar radiation storms continue to carry a daily slight chance of reaching S1 or greater through the period, beginning to abate into the coming UTC weekend.

Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	50	50	40	40
Very Active	R3 to R5 X	No	5	5	1	1

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	15	15	15	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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